

# Objectives, database and methodologies

## 2.1 Objectives of the study

The present study aims at developing a feasible and holistic river restoration procedure for the Kolong River with the following objectives:

- To conduct a baseline study and to establish a comprehensive inventory of the geo-environmental and eco-biological settings of the Kolong River Basin.
- To examine the hydrological characteristics of river Kolong, its tributaries vis-à-vis the Brahmaputra.
- To explore the socio-economic aspects of the Kolong River and to understand the relationship between the river and the riparian population.
- To examine the pattern of land use/ land cover change of in the study area and to conduct a broad study focusing on the relationship between NDVI

and precipitation with a view to examine the vegetative health of the area under study.

- To determine the hydraulic geometry relationships in regard to the Kolong River channel.
- To assess the channel planform and rate of channel migration over a period of 103 years i.e. from 1912 to 2015.
- To suggest suitable river restoration and watershed management strategies for the Kolong River with a focus on their long-term sustenance.

## **2.2 Working hypothesis**

The different hypotheses used for carrying out the present research are as follows-

- The ecological and biological integrity of a natural river course need not be disturbed. The Kolong river of Nagaon, Assam which about 60 years back from now was a free flowing natural system has now been converted into a dead river as a result of obstructing the mouth of the river by constructing a dyke in order to prevent floods. The blocking of the river is not at all a wise act as it resulted in the loss of the ecological as well as the biological integrity of the river and its basin.
- There is an urgent need for restoration of the river in order to make it a viable system that could contribute towards enhancing ecological integrity, biological productivity and various economic services to the riparian community.

- Restoration of the river system is also necessary in order to enhance the aesthetic values of the riverine landscape.

## 2.3 Database

The present research is a combination of extensive field work and laboratory analysis with remote sensing data and GIS playing a significant role. The database involved both primary data collected in the field as well as a variety of collateral data obtained from various government departments, academic institutions, published documents and reports of research organizations, individual scholar's publications, books, journals and internet. The details of various datasets used during the study are given below:

- Primary water and soil quality data obtained using standard field and laboratory procedures were used for the purpose.
- Survey of India Topographical sheets of two different time periods viz. 1912-1914 and 1967-1968 having spatial resolution of 1:63,360 and 1:50,000 respectively were used for the study. The toposheet numbers are : 78N/15, 78N/16, 83B/2, 83B/3, 83B/4, 83B/6, 83B/7, 83B/8, 83B/10, 83B/11, 83B/12, 83B/14, 83B/15, 83B/16, 83C/1, 83C/9, 83F/2 and B3F/3
- Satellite imageries obtained from various open source domain such as GLCF Earth-explorer, Bhuvan etc. served as an important set of database in the present study. The various satellite database used were: LANDSAT-MSS (1987), LANDSAT-TM (1999), LANDSAT-ETM+ (2006), IRS-LISS III (2014), ASTER-GDEM (2014) etc.

- *Dji* UAV images obtained in the RGB band using optical camera at the river take-off point were utilized as a vital source of spatial dataset used for restoration planning.
- Soil map of Assam prepared by National Bureau of Soil Survey (NBSS) was used as an important set of information in the present study for soil map generation and hydrological soil grouping during basin runoff-estimation.
- Hydro-meteorological data were collected from wide range of sources namely Water Resource Department, Government of Assam; Irrigation Department, Government of Assam; Brahmaputra Board; Indian Meteorological Department (IMD), Government of India, Public Health Engineering (PHE) office and Municipality Board, Nagaon etc.
- Hydro-geomorphological map and village map were collected from Assam Remote Sensing Application Center (ARSAC).
- For the socio-economic survey, a questionnaire specially designed for the purpose had been used (Annexure E).

## 2.4 Methodology

In order to conduct a successful scientific work, it is necessary to adhere to a set of standard and systematic methodologies. Since, the present study comprises interplay of diverse themes of work, the methodology used in addressing each theme is also varied. Hence, methodologies that were employed during the study are discussed elaborately in relevant chapters. However, on a broad sense, the whole work is grouped into three phases. They are the **investigation or survey phase**, the

**map generation, data analysis and interpretation phase** and the **modeling and planning phase**.

The **investigation stage** involved a comprehensive field survey of the study area, identification of sampling sites for various purposes, collection of water and soil samples and their laboratory analysis, collection of various SOI toposheets, satellite imageries, Unmanned Aerial Vehicle (UAV) imageries, site photographs and other collateral maps and relevant literatures. Various departments were visited during this phase for collection of information available with them. A widespread literature review was carried out and previous works were assessed. A standard questionnaire was specially designed for the purpose and village level socio-economic survey was conducted following a sampling technique based on stratified random method.

In the second phase, various techniques were applied to construct different thematic maps for serving the research purpose. Different GIS and digital image processing softwares like ArcGIS 9.3, ERDAS IMAGINE 9.1, Pix4D and Q-GIS 2.2 were used for displaying and visual interpretation of the spatial databases and for preparation of different thematic maps. For any GIS based analysis, the first and foremost requirement is to georeference the available toposheets and to make sure that all the generated thematic layers are in the same coordinate system which in turn will ensure the super-imposition of the generated thematic layers. Hence, various toposheets were first georeferenced using Kaliyanpur-1975 geographic co-ordinate system; thereafter they were transformed into WGS84 datum and then projected to UTM (Zone46) projection. The orthorectified satellite images having UTM projection were used directly after proper radiometric corrections. Moreover, the UAV images

used for the present purpose were geo-coded. The various maps thus generated were mainly used for the following purposes:

1. For proper planning and execution of a field based study, firsthand information regarding the location of the study area and its accessibility is necessary. Thus, a base map of the study area depicting the rivers, important locations, roads, railway lines etc was prepared based on the toposheets (1967-68).
2. For landuse/landcover mapping six broad classes viz. Forest land, Built-up area, Agricultural land, Shrub/grass land, Wetland and Open space were finalised. In order to obtain better accuracy, on-screen digitization aided by standard visual interpretation techniques based on tone, texture, shape, size, pattern, association, location etc., in addition to the local knowledge of the interpreter was preferred in the present study.
3. NDVI maps are important in depicting the vegetative health of the study area and thus were prepared based upon satellite imageries of different years using raster calculator of ArcGIS as the primary tool.
4. Various other geomorphological maps such as geological map, hydrogeomorphological map, soil map etc were prepared by considering already prepared standard maps obtained from various agencies as base layers.
5. Mapping of the centreline of a river channel during different time frames is necessary to estimate the extent of channel shifting. Thus, the meandering river channel and the channel centreline were mapped and

finally the extent of erosion/aggradation and rate of channel migration was determined.

6. Orthomosaic image and Digital Surface Model (DSM) of the Kolong River takeoff point were also prepared using Pix4D software which helped in understanding the elevation differences of the bed terrain.

Adequate ground truth data were obtained by using handheld Garmin GPS. Final compositions of different maps were done in ArcGIS 9.3 and Pix4D softwares.

During the **modelling and planning phase**, all the valuable research findings obtained during the course of the present study were compiled together and finally a holistic river restoration design is formulated. Softwares like HEC-RAS, HEC-GeoRas etc. played an important role in generating different flow simulation scenarios. At last, few suggestions regarding sustainable watershed management were cited.